Natural Resource Management

Fire Management.

Background.

Wildfires have been a component of upland ecosystems on Cape Cod for thousands of years. Prior to European settlement, Cape vegetation was frequently burned by both natural and anthropogenic wildfires (Backman, 1984; Day, 1953; Patterson and Sassman, 1988), and it is likely that fire has played a role in the spatial heterogeneity of upland vegetative cover on the outer Cape. Since the establishment of Cape Cod National Seashore in 1961, however, CACO staff have aggressively suppressed all wildfires within the seashore's boundary, limiting total burned acres to less than 40 hectares in as many years. The effect of this full-suppression policy on forest fuels and vegetative communities within the seashore remains unknown, but it is hypothesized that complete fire suppression may lead to more uniform forest cover, the decrease and eventual disappearance of fire-dependent communities such as grasslands and heathlands, an increase in surface water acidity and an unprecedented accumulation of organic matter with the potential to fuel an uncontrollable and highly destructive wildfire.

An average of 10 to 15 ignitions occur each year at CACO, all the result of human carelessness or mischief (Dosmann and Patterson, 1990). When paired with climate and forest fuel factors, this human impact can create the potential for hazardous wildfires on the outer Cape. The abundance of black huckleberry (*Gaylussacia baccata*) in much of the park's pine-oak forests also presents a fire management concern, because it contains volatile oils that burn explosively when ignited. Since 1985, CACO and cooperative research units at the University of Massachusetts have been conducting prescribed burning and collections of vegetation response data in a 7-hectare site in South Truro. This research has, in turn, led to the development of several Cape-specific fuel models, which are currently being tested under prescribed burning conditions on one- to five-acre plots at the Truro site. Burns took place in 1999, 2000 and 2001, and are planned to continue through 2004.

Research Needs.

Map Hazard Fuels: The accumulation of forest fuels at CACO has increased dramatically in recent years, largely as a result of insect, wind and disease damage. Pitch pine (*Pinus rigida*) communities have been particularly hard hit, with turpentine beetles (*Dendroctonus* sp.) leading to blue stain fungal infection in stands as large as twenty hectares. Updated hazard fuel mapping and sampling, including biomass measurements, are needed in order to make informed decisions regarding fire management in the park.

Assess Forest Pest Damage: The United States Forest Service (USFS) coordinates annual nationwide gypsy moth monitoring using a variety of sampling techniques, including traps, burlap bands and aerial surveys. Gypsy moth populations appear to be on the rise in Massachusetts, and continued monitoring using the USFS methods is necessary in order to track changes in the local abundance of this devastating invasive species and to formulate park-specific gypsy moth management actions. Annual surveys of browntail

Fire Management, continued.

moths and other forest pests are also needed in order to inventory and assess the damage caused by insect pests in CACO forests. When possible, survey results should be linked to environmental factors such as temperature and drought status in order to provide resource managers with a tool for predicting damaging infestations and subsequent hazard fuel accumulations.

(See related project description under "The Browntail Moth" and "The Gypsy Moth" in the Wildlife Ecology chapter.)

Investigate Suppression Impacts: Although it is hypothesized that CACO's policy of complete wildfire suppression could precipitate a decline in habitat heterogeneity or result in a major uncontrolled wildfire with extensive natural and cultural repercussions, little quantitative information about the impacts of fire suppression on the outer Cape actually exists. A thorough investigation of fire suppression impacts on Cape ecosystems is needed, followed by long term monitoring of CACO's plant communities and computer modeling of future vegetation trends. The fuel loading transects completed by Patterson, et al. in 1984 should be re-surveyed, and research should be undertaken to determine the present level of fuel loading in the park, as well as the average rate of accumulation.

Test Fuel Models for Coastal Pine Communities: Five years of research on huckleberry (Patterson, et al., 1984) has produced data on vegetation response to fire, fire rate-of-spread and fireline intensity for prescribed burns in the huckleberry understory of oak-pine forest, and ongoing research on the effects of fire on coastal pine communities has resulted in the development of CACO-specific fuel models with huckleberry components. Field validation trials are currently in progress at one site in South Truro; however, at least four discrete areas need to be tested in order to check the validity of these models. Continued testing of custom fuel models is thus necessary.

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Land Use Mapping.

Background.

The last thirty years have brought unprecedented population growth to Cape Cod, along with a boom of residential and commercial development that shows little sign of slowing. Between 1970 and 2000, the number of year-round Cape Cod residents doubled to 200,000, the number of Cape housing units increased by a dramatic 76 %, and despite the ability of Cape Cod National Seashore to protect pristine land inside its boundaries from major development, increasing numbers of privately-owned seasonal cottages within the park have been, and continue to be, redeveloped and converted to year-round residences. Forest clearance, extended pavement and new roads, additional on-site wastewater disposal and increased use of pesticides and fertilizers in areas within and adjacent to CACO all pose a serious threat to the outer Cape's aquatic and terrestrial resources. Rather than attempting to assess each development project individually, Geographic Information System mapping and analysis are expected to provide a more systematic, comprehensive and scientifically credible way to assess the cumulative impacts of development on outer Cape Cod.

Research Needs.

Regular land use mapping and analysis, using CACO's GIS, is needed to monitor and assess rapid land use changes on the outer Cape. Although preliminary data can be acquired from MassGIS (Commonwealth of Massachusetts, EOEA -- land use, wetlands and conservation lands data from 1999 are now available for internet download), sources of impact such as new construction, subdivisions, large paved areas, lawns, underground storage tanks and new septic systems need to be mapped from aerials, field visits and assessor's records. The GIS analysis should include hydrologic (groundwater and surface water flow direction and velocities) and geologic (soils and surficial geology) information to predict development effects on downgradient wetlands, ponds and estuaries. Additionally, specific GIS Software tools and applications for predicting groundwater effects need to be identified and tested for use at CACO.

Long-Term Weather Database.

Background.

The success of nearly all ecological field research and monitoring at Cape Cod National Seashore, as well as the investigation of oil spills, wildfires, insect dispersion and other unexpected impacts to CACO natural resources, is dependent upon accurate and accessible meteorological information. Presently, precipitation data are recorded continuously at the Truro National Atmospheric Deposition site and Race Point Ranger Station, and National Oceanic and Atmospheric Administration observations are collected at weather stations in Provincetown and Chatham. Fire weather observations including temperature, RH, precipitation, fuel stick moisture, and wind speed and direction are collected hourly during fire season on a data logger, which is downloaded as needed for fire indices determinations.

Research Needs.

A standardized protocol for monitoring meteorological and atmospheric conditions at CACO is currently being developed in partnership with the United States Geological Survey. Upon its completion, long-term monitoring needs to be initiated and subsequent data integrated, along with past and present fire weather observations, into a comprehensive weather database. As an important tool for enhancing research and information across the resource management spectrum, the database should be formatted for easy retrievability by CACO resource managers.

Vegetation Mapping.

Background.

Up-to-date vegetation maps are an important component of vegetation and fuels management, and are vital to predicting ecological change stemming from natural processes, unplanned human intervention and habitat restoration projects. Accurate historical vegetation cover maps are also necessary to track changes in plant communities over time and to provide context for other kinds of habitat mapping and research within Cape Cod National Seashore's Inventory & Monitoring program. Vegetation cover mapping needs to be completed at ten-year intervals (and in areas of rapid change, every five years or less) in order to accurately correlate information with other monitoring protocols. With the cooperation of the University of Massachusetts, an updated vegetation map is currently being generated based on aerial photos from 2000; the next update should occur by 2010. Traditional hard-copy photogrammetry methods are still being utilized, but as high resolution satellite imagery becomes more available and new remote sensing classification methods build proven track records, these methods may also be considered.

Research Needs.

Restore Historic Maps: Historical cover and vegetation maps are a valuable source of information which, if their methods and accuracy can be verified, may add decades to the long-term record of vegetation and land use changes on outer Cape Cod. Historical land cover and vegetation map sources for the outer Cape exist in various forms: hard-copy vegetation polygon maps from 1958 and 1977 (with partial digital versions), U.S. Coastal Survey Maps from 1836-1868 and 1943, and complete aerial photo sets from 1938, 1947, 1960, 1977 and 1987. Other recent photo sets are also becoming available from the Commonwealth of Massachusetts. Information from each of these sources needs to be digitized, interpreted, checked against contemporary evidence and verified, as well as metadata prepared. The final geographic data standard dictates ArcInfo format, UTM coordinate system, North American Datum 1983 (usable in Arcview 3.2a and subsequent versions of ESRI software).

Verify Current Maps: Current and future vegetation mapping efforts need field verification, and statistical field sampling (including ordination analysis) is needed for a more precise record of vegetation type composition. Once sampling methods have been standardized, field sampling and verification efforts should be repeated at regular intervals. Current data should also be compared to historical information using descriptive methods. Additional query/analysis may be possible based on specific questions of habitat change and wildlife dynamics, such as trends in heathland, wetland and forest composition, threatened species productivity, predator interactions and forest pests.

Additional Projects in Natural Resource Management.

Many natural resource management projects at Cape Cod National Seashore also fall under other areas of study. See below for additional natural resource management projects listed in this catalog under their primary field:

Aquatic Ecology

Atmospheric Monitoring

Coastal Geomorphology

Plant Ecology

Additional Projects in Natural Resource Management, continued.

Wildlife Ecology

Cultural Resource Management

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